

## **CURRICULUM VITAE**

### **Christopher D. Knight, Ph.D**

31 Ranch Court  
St. Louis, MO 63146  
(314) 567-6627 (h)  
(636) 926-7401 (o)

#### **Education**

1977- 1981	Ph.D. in Monogastric Nutrition Purdue University, West. Lafayette, IN Department of Animal Science. Graduate Instructorship, 1977-1981
1975- 1977	M.S. in Monogastric Nutrition Purdue University, West. Lafayette, IN Department of Animal Science. Graduate Research Assistant
1973- 1975	B.S. Animal Sciences Cornell University, Ithaca, NY
1971- 1973	A.A.S. Science Laboratory Technology State University of New York at Cobleskill

#### **Employment**

2001- Present	Department Head, Research & Development Novus International, Inc.
1996- 2001	Director New Business Development Novus International, Inc.
1991- 1995	Manager and Director Nutrition Research Novus International, Inc
1987- 1991	Research Group Leader Monsanto Company Animal Sciences Division Porcine Somatotropin Group
1981- 1986	Research Specialist and Research Group Leader Monsanto Company Alimet Metabolism and Applications Research Group

## Key Accomplishments

- Developed foundation data quantifying availability of ALIMET® Feed Supplement as a by-pass methionine source in lactating dairy cattle and methods to predict methionine deficiency using existing nutritional models. These data resolved decades of research work to attempting to commercialize this product application that had failed due to unpredictable field results. The research demonstrated Alimet to be the most cost-effective source of post-ruminal methionine activity available, resulted in a US patent and the development of a \$5M/yr business for Novus. As of 2005, a new Ruminant Business Unit of 20 employees and agents and a portfolio of 8 products (including Alimet and MHA) for the dairy industry has been formed.
- Led the development and commercialization of OASIS® Hatchling Supplement, a hydrated nutritional supplement fed to young poultry in transit or to stimulate rapid onset of ad libitum feeding after placement. This patented product developed a new market in the poultry industry based on developmental research at Novus showing the impact of early nutrition on subsequent long term performance and health. Cumulative sales of this niche product have exceeded \$4M and resulted in the development of gastrointestinal health as a core research and development competency within Novus.
- Led the technology development, regulatory approval and early commercialization of ADVENT® Coccidiosis Control, an orally applied coccidiosis vaccine based upon technology that permits the in vitro determination of oocyst viability such that a vaccine of consistent potency can be produced and marketed. This represented a new area of technology for Novus and in 2003, a jury of scientists and technology experts from Washington University and St. Louis University awarded the developers of this technology (Dr. Julia Dibner and Dr. Chris Knight) with The St. Louis Technology Award. The Advent Coccidiosis Control technology was among eight other winners from approximately 70 nominations in the St. Louis vicinity. In determining winners, the judges considered the scope, economic impact and overall significance of the new technology. Facilitated by the Academy of Science of St. Louis, the judging process also examined the level of sophistication of the entries and the innovation utilized to bring it to fruition. This technology represents a keystone of a business strategy that focuses on gastrointestinal health and drug-free poultry production.
- Established a new cost-efficient method of product development research, to insure Novus' capability to conduct scientifically and commercially relevant research across multiple species without requiring ownership or hands on care and management of research facilities. Initially divested Novus-owned animal research facilities and sought collaborative investment opportunities with scientific professionals in animal agriculture to provide capital for research facilities that would be controlled by the research partner but provide Novus with preferred status for conduct of research. To date we have formed 3 partnerships like this in the US that permits routine product development work in broilers, swine (weaning, grow-finish and lactating sows) and dairy cattle, all in commercial scale production environments. Similar agreements are

under development in Brazil (commercial scale egg layer research) and China (commercial scale swine research including wean, grow-finish and sow nutrition).

- The foundation product for Novus International is ALIMET® Feed Supplement, a source of methionine activity referred to as methionine hydroxyl analog or chemically DL-2-hydroxy-4-(methylthio) butanoic acid. Today this business represents approximately \$400M in annual revenue to Novus in a \$1B methionine market, however, in 1981 this represented about a \$20M business. In the course of my 25 year involvement with this product there has been a heated commercial controversy with respect the relative efficacy of Alimet and the competitive product DL-methionine (DLM). A close colleague (Dr. Julia Dibner) and I have had the responsibility of understanding the absorption, metabolism and utilization of Alimet, how it differs from that of DLM and the impact that the differences have on the commercial value of Alimet relative to DLM. Today based on a variety of independent and collaborative research efforts it is understood that the metabolism of Alimet is very different from DLM, that those differences result in differences in ad libitum feed intake (less than DLM at low supplementation rates, greater than DLM at the maximum response level) resulting in different dose responses for the two methionine sources. A substantial part of the controversy was based on the a priori assumption that the two products must have the same dose response since they both provide methionine. With collaboration with various statistical experts, we have been able to establish that the two products in fact have different dose responses and have described the appropriate statistical methods for comparing two products that exhibit different dose responses (Poult. Sci. 85:947-954). The controversy will continue due to commercial conditions (Alimet is less expensive to manufacture than DLM) , however over the course of 25 years Alimet has continued to grow at a 25% compounded annual growth rate with over a 50% market share in the US. The science applied to this commercial issue has laid the technical foundation that has provided Novus with the technical credibility to expand our product offerings from amino acids into nutritional organic acid blends, organic trace minerals, ingredient preservation and coccidiosis control.

ALIMET® Feed Supplement, OASIS® Hatching Supplement and ADVENT® Coccidiosis Control are registered trademarks of Novus International, Inc., St. Louis, MO.

## **Personal**

- Married 1982: Sandra J. Rogers (Purdue Food Science MS 1978).
- Children: Adam (19), Evan (16), Audrey (14)

## **Community Involvement**

- Subdivision Trustee: 1987-1989: Led resolution of road and storm sewer repair dispute
- St. Peter's Episcopal Church:
  - Youth Sponsor: 1984-1988
  - Sunday School Teacher: 1992-2006 (Variety of grades and curricula)
  - Vestry: 1989-1993
  - Founding Christian Education Commission & Chair: 1989-1993
  - Confirmation Teacher: 2005-6.
  - Founding and sustaining member of Haven of Grace: Home for unwed mothers
- Hobbies
  - Cooking
  - Gardening
  - Kid's Sports

## PUBLICATIONS & PROCEEDINGS

1. Dibner, J.J. and **C.D. Knight** (1984) Conversion of 2-hydroxy-4-(methylthio) butanoic acid to L-methionine in the chick: A stereospecific pathway. *J. Nutr.* 114:1716-1723.
2. **Knight, C.D.** and J.J. Dibner (1984) Comparative absorption of 2-hydroxy-4-(methylthio)butanoic acid and L-methionine in the broiler chick. *J. Nutr.* 114:2179-2186.
3. Dibner, J.J., F.J. Ivey, C.Q. Lawson and **C.D. Knight** (1986) *In vitro* methods in animal nutrition. *Proceedings of the Conference European D'Aviculture* 7:312-316.
4. Dibner, J.J., **C.D. Knight**, R.A. Swick and F.J. Ivey (1987) Absorption of 2-hydroxy-4-(methylthio) butanoic acid from the hindgut of the broiler chick. *Poult. Sci.* 67:1314-1321.
5. Dibner, J.J., **C.D. Knight**, C.Q. Lawson, R.A. Swick and F.J. Ivey (1990) Studies of the metabolism of 2-hydroxy-4-(methylthio)butanoic acid (HMB, Alimet®) in the broiler chick using *in vitro* methods. *Memorias: XI Congreso de Avicultura Centroamericano y del Caribe*, pp15-18.
6. **Knight, C.D.**, J.J. Dibner and F.J. Ivey (1991) Crystalline amino acid diets for chicks: History and future. *Maryland Nutrition Conference Proceedings* pp 19-28.
7. **Knight C.D.**, Kasser T.R., Swenson G.H., Hintz R.L., Azain M.J., Bates R.O., Cline T.R., Crenshaw J.D., Cromwell G.L., Hedrick H.B. 1991. The performance and carcass composition responses of finishing swine to a range of porcine somatotropin doses in a 1-week delivery system. *J. Anim. Sci.* 69:4678-89.
8. Collier R.J., Vicini J.L., **Knight C.D.**, McLaughlin C.L., Baile C.A. 1992. Impact of somatotropins on nutrient requirements in domestic animals. *J. Nutr.* 12293 (Suppl):855-60.
9. Becker B.A., **Knight C.D.**, Veenhuizen J.J., Jesse G.W., Hedrick H.B. Baile C.A. 1993. Performance, carcass composition, and blood hormones and metabolites of finishing pigs treated with porcine somatotropin in hot and cold environments. *J Anim Sci.* 71:2375-87.
10. Becker. B. A., **C.D. Knight**, F.C. Buonomo, G.W. Jesse, H.B. Hedrick, C. A. Baile. 1992. Effect of a hot temperature environment on performance, carcass characteristics, and blood hormones and metabolites of pigs treated with porcine somatotropin. *J. Anim. Sci.* 70: 2732-40.

11. Ledoux, D.R., **C. D. Knight**, B. A. Becker and C.A. Baile. 1993. Effects of a porcine somatotropin implant on tissue mineral status of finishing pigs exposed to a thermoneutral or cold environment. *J. Anim. Sci.* 1993. 71:2180-2186.
12. **Knight, C.D.**, C.W. Wuelling, C.A. Atwell and J.J. Dibner. 1994. Effect of Intermittent Periods of High Environmental Temperature on Broiler Performance Responses to Sources of Methionine Activity. *Poultry Science* 73:627-639.
13. Hammond B.G., Vicini J.L., Hartnell G.F., Naylor M.W., **Knight C.D.**, Robinson E.H., Fuchs R.L., Padgett S.R. 1996. The feeding value of soybeans fed to rats, chickens, catfish and dairy cattle is not altered by genetic incorporation of glyphosate tolerance. *J Nutr.* 1996. 126(3):717-27.
14. **Knight, C.D.**, C.A. Atwell. C.W. Wuelling, F.J. Ivey and J.J. Dibner, 1998. The relative effectiveness of 2-hydroxy-4-(methylthio) butanoic acid and DL-methionine in young swine. *J. Anim. Sci.* 76:781-787.
15. Dibner, J.J., F.J. Ivey, and C.D. Knight. 1998. The feeding of neonatal poultry. *World Poultry*, No. 5, Vol. 14: 36-40.
16. Dibner, J.J., **C.D. Knight**, M.L. Kitchell, C.A. Atwell A.C. Downs and F.J. Ivey, 1998. Early feeding and development of the immune system in neonatal poultry. *J. App. Poult. Res.* 7:425-436.
17. Dibner, J.J., F.J. Ivey and **C.D. Knight**, 1999. Direct delivery of live coccidiosis vaccine into the hatchling yolk sac. *World Poultry-Coccidiosis Special* p. 28-29.
18. Koenig K.M., L. M. Rode, **C. D. Knight**, and P. R. McCullough. 1999. Ruminal escape, gastrointestinal absorption, and response of serum methionine to supplementation of liquid methionine hydroxyl analog in Dairy cows. *J. Dairy Sci.* 82:355-361.
19. Dibner, J.J., and **C.D. Knight**. 2001. Early Feeding and Nutritional Programming in Hatchling Poultry. *Proceedings Arkansas Nutrition Conference*, Sept. 11-13.
20. Koenig K.M., M. Vázquez-Añón, **C. D. Knight**, and L. M. Rode. 2002. Ruminal escape and response of serum methionine to 25 and 50 grams of methionine hydroxy analog in dairy cows. *J. Dairy Sci.* 85:930
21. Dibner, J.J. and **C.D. Knight**, 2003. Early nutrition and immune development. *Proceedings: California Animal Nutrition Conference*, pp. 172-178. Fresno, CA, May 13 & 14, 2003.

22. Dibner, J.J., and **C.D. Knight**. 2003. Early Nutrition: Effect of feed and water on livability and performance. Proceedings: 27<sup>th</sup> North Carolina Turkey Industry Days. pp 12- 17.
23. Dibner, J.J., M.A. Pfannenstiel, M.L. Kitchell and **C.D. Knight**, 2003. Importance of viability testing for coccidiosis vaccines. World Poultry-Coccidiosis Special p. 11-12.
24. Dibner, J.J., M.A. Pfannenstiel, J.K. McMillen, J. Green, and **C.D. Knight**. 2003. Safety and Efficacy of a high definition coccidiosis vaccine. Proceedings of the Fifty-Second Western Poultry Disease Conference, March 8-11. pp 83-86.
25. Vazquez-Anon, M., M. Wehmeyer, T. Hampton, **C.D. Knight** and J.J. Dibner, 2003. Differential response to 2-hydroxy-4-(methylthio) butanoic acid and DL-methionine above requirements on broiler and pig performance and iron metabolism.. EEAP Publication 109: Progress in Research on Energy and Protein Metabolism, pg. 725-729.
26. Dibner, J.J., M. Quiroz, S.J. Mueller and **C.D. Knight**, 2004. Recent developments in broiler coccidiosis control: Comparison of vaccination with coccidiostats in broilers on used litter. Zootecnica International, March, 2004: 44-49.
27. Dibner, J.J., M. Vazquez-Anon, David Parker, Ricardo Gonzalez-Esquerria and **C.D. Knight**, 2004. Use of Alimet<sup>®</sup> Feed Supplement (2-hydroxy-4-methylthio butanoic acid, HMBTA) for broiler production. Japanese J. Poultry Sci., 41:214-223.
28. Gaines A.M., Yi G.F., Ratliff B.W., Srichana P., Kendall D.C., Allee G.L., **Knight C.D.**, Perryman K.R. 2005. Estimation of the ideal ratio of true ileal digestible sulfur amino acids:lysine in 8- to 26-kg nursery pigs. J Anim. Sci.83:2527-34.
29. Vázquez-Añón, M. D. Kratzer, R. González-Esquerria, I. G. Yi, and **C. D. Knight**. 2006. A Multiple Regression Model Approach to Contrast the Performance of 2-Hydroxy-4-Methylthio Butanoic Acid and DL-Methionine Supplementation Tested in Broiler Experiments and Reported in the Literature. Poult. Sci. 85: 693-705.
30. Vazquez-Añón, M., R. Gonzalez-Esquerria, T. Hampton, J. Firman, and **C. D. Knight**. 2006. Evidence for 2-Hydroxy-4-Methylthio Butanoic Acid and DL-methionine having a Different Dose-Response in Growing Broilers. Poult. Sci. 85: (In Press).
31. G. F. Yi, A. M. Gaines, B. W. Ratliff, P. Srichana, G. L. Allee, K. R. Perryman, and C. D. Knight. 2006. Estimation of the true ileal digestible lysine and sulfur amino acid requirement and comparison of the bioefficacy of 2-hydroxy-4-(methylthio)butanoic acid and DL-methionine in 11- to 26-kg nursery pigs. J. Anim. Sci. 84: (In Press).

32. G. F. Yi, J. J. Dibner, C. S. Schasteen, J. Wu, K. R. Perryman, and **C. D. Knight**. 2006. Evaluation of 2-hydroxy-4-(methylthio)butanoic acid (HMTBa) and HMTBa containing ACTIVATE® nutritional feed acid blend in different nursery pig feeding programs. J. Anim. Sci. (Submitted).

### Patents

1. Ivey, F.J., J.J. Dibner, and **C.D. Knight**, 1999. Nutrient formulation and process for enhancing the health, livability, cumulative weight gain or feed efficiency in poultry and other animals. Patent number 5,976,580.
2. Ivey, F.J., J.J. Dibner, and **C.D. Knight**, 1999. Nutrient formulation and process for feeding young poultry and other animals. Patent number 5,985,336.
3. **Knight, C.D.**, K. Koenig, L. Rode, M. Vandenberg, and M. Vázquez-Añón 2000. Process for optimizing milk production. Patent number 601,753